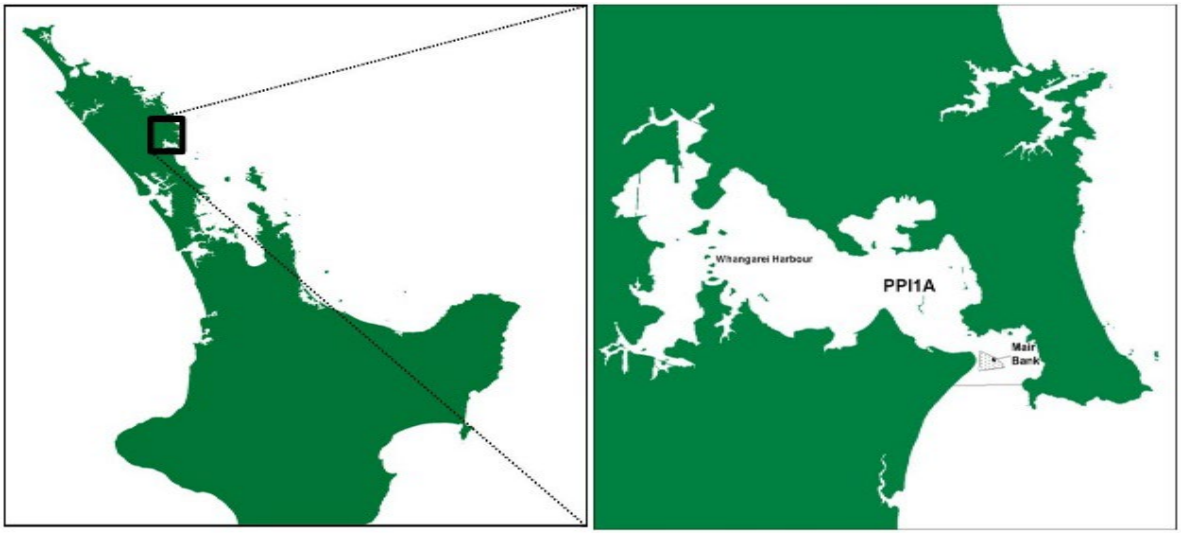
PPI (PPI 1A) Mair Bank (Whangarei Harbour)

(*Paphies australis*)
Pipi



1. FISHERY SUMMARY

PPI 1A was introduced into the Quota Management System (QMS) on 1 October 2004 with a TAC of 250 t, comprising a TACC of 200 t, and customary and recreational allowances of 25 t each.

Marsden Bank was closed to the collection of pipi in February 2011, with the subsequent closure of adjacent Mair Bank on 1 October 2014 due to historically low pipi biomass levels. Marsden Bank was included in the monitoring programme in 2009–10, and has been surveyed another four times (2012, 2014, 2018 amd 2022) since then (Berkenbusch et al., 2022). Pipi were absent at Marsden Bank in 2021–22, and none of the 60 monitoring samples contained any pipi. Their renewed decline at this site followed signs of recovery recorded in the 2017–18 survey, when the estimated abundance of pipi was 10.93 million (CV: 19.17%) indidviduals at an average density of 1284 pipi per m^2. Pipi at this site have also been assessed in other recent surveys, including a community-based monitoring programme led by Patuharakeke iwi (Williams et al. 2017).

1.1 Commercial fisheries

Prior to 2004, the year FMA PPI 1 and FMA PPI 1A (Whangarei Harbour) were introduced to the QMS, the commercial fishery area in Whangarei Harbour was defined in regulation as the area within 1.5 nautical miles of the coastline from Home Point, at the northern extent of the Whangarei Harbour entrance, to Mangawhai Heads, south of the harbour. The fishery was limited by daily limits which summed to 657 t greenweight in a 365 day year, but there was no explicit annual restriction.

Commercial fishers typically gathered pipi from the seaward edge of Mair Bank, particularly the southern end, and avoided the centre of the bank itself where there is a lot of shell debris. Regulations require that all gathering be done by hand, and fishers typically use a mask and snorkel. There is no minimum legal size (MLS) for pipi, although a sample measured from the commercial catch in PPI 1A in 2005 suggested that fishers favour larger pipi (over 60 mm SL, Williams et al. 2007). Pipi have in the past been harvested year-round, so there is no apparent seasonality in the fishery.

Over 99% of the total commercial landings of pipi in New Zealand over time have been from General Statistical Area 003 and and FMA PPI 1. Later on, when a distinction was made between the two areas, virtually all the landings have been from PPI 1A (Whangarei Harbour). Total commercial landings of pipi reported on Licensed Fish Receiver Returns (LFRRs) remained reasonably stable through time, averaging 177 t annually in New Zealand from 1986–87 until 2009–10 (Table 1). Landings subsequently decreased to an average of just 71 t in 2010–11 to 2011–12; no landings were reported

after 2012. The highest recorded landings were in 1991–92 (326 t). There is no evidence of any consistent seasonal pattern in either the level of effort or catch per unit effort (CPUE) in the pipi fishery. CPUE in the pipi targeted fishery increased between 1989–90 and 1992–93, was then relatively stable up to 2002–03 but increased in 2003–04 and 2004–05 (Williams et al. 2007). No CPUE information has since been analysed.

Table 1: Reported commercial landings (from Licensed Fish Receiver Returns; LFRR) of pipi (t greenweight) since 1986–87.

Year	Reported landings (t)	TACC (t)	Year	Reported landings (t)	TACC (t)
1986–87	131	657	2005–06	137	200
1987–88	133	657	2006–07	135	200
1988–89	134	657	2007–08	142	200
1989–90	222	657	2008–09	131	200
1990–91	285	657	2009–10	136	200
1991–92	326	657	2010–11	87	200
1992–93	184	657	2011–12	55	200
1993–94	258	657	2012–13	0	200
1994–95	172	657	2013–14	0	200
1995–96	135	657	2014–15	0	200
1996–97	146	657	2015–16	0	200
1997–98	122	657	2016–17	0	200
1998–99	130	657	2017–18	0	200
1999–00	143	657	2018–19	0	200
2000–01	184	657	2019–20	0	200
2001–02	191	657	2020–21	0	200
2002–03	191	657	2021–22	0	200
2003–04	266	657	2022–23	0	200
2004–05	206	200			

Prior to the introduction of PPI 1A to the QMS, there were nine permit holders for Whangarei Harbour. No new entrants have entered the fishery since 1992, when commercial access to the fishery was constrained by the general moratorium on granting new fishing permits for non-QMS fisheries. Access to the fishery has, however, been restricted through other regulations since the mid-1980s, and more formally since 1988. Under previous non-QMS management arrangements, there was a daily catch limit of 200 kg per permit holder, meaning that collectively the nine permit holders could theoretically take 657 t of pipi per year. The permit holders indicated that annual harvest quantities were considerably less than the potential maximum because of the relatively low market demand for commercial product rather than the availability of the resource. On 1 October 2004, pipi in Whangarei Harbour (PPI 1A) were introduced into the QMS, and the nine existing permits were replaced with individual transferable quotas. The 200 kg daily catch limit no longer applies. A total allowable catch (TAC) of 250 t was set, comprised of a total allowable commercial catch (TACC) of 200 t, a customary allowance of 25 t, and a recreational allowance of 25 t.

Figure 1 shows the historical landings and TACC values for PPI 1A. After 1 October 2014, all take of pipi from Mair Bank was prohibited due to historically low pipi biomass levels.

1.2 Recreational fisheries

The only estimate of recreational harvest of pipi comparable with the commercial fishery on Mair Bank is the estimate of harvest from the whole of Whangarei Harbour from the 2011–12 National Panel Survey (<1 tonne, see Table 3 in Introduction – Pipi chapter). Thus, the recreational harvest of pipi from the bank was small relative to commercial landings there prior to 1 October 2014. After 1 October 2014 all take of pipi from Mair Bank was prohibited due to very low biomass levels.

For further information on recreational fisheries refer to the Introduction – Pipi chapter.

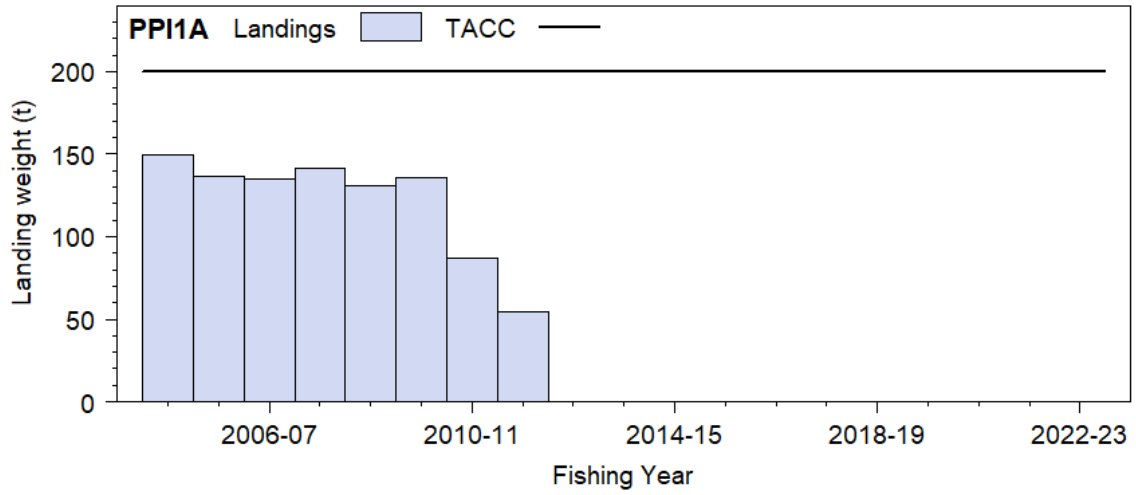


Figure 1: Total commercial landings and TACC for PPI 1A (Whangarei Harbour). QMS data from 2004–05 to present.

1.3 Customary non-commercial fisheries

In common with many other intertidal shellfish, pipi are very important to Māori as a traditional food.

Māori customary fishers can utilise the provisions under both the Fisheries (Amateur Fishing) Regulations 2013 and the Fisheries (Kaimoana Customary Fishing) Regulations 1998. Patuharakeke gazetted their rohe moana which covers the southern shoreline of the Whangarei harbour in 2009. In 2021, Te Rerenga Parāoa gazetted their rohe moana which covers the northern side of the Harbour and sits adjacent to the Patuharakeke Rohe Moana on the south side of the Harbour. The entire Whangarei Harbour is now a gazetted Rohe Moana. When tangata whenua harvest pipi under their recreational allowance, these are not included in records of customary catch.

Estimates of customary catch under the provisions made for customary fishing for PPI 1A between 2008-09 and 2012-13 are shown in Table 2. These numbers are likely to be an underestimate of customary harvest because only the approved and harvested catch in weight (kg) are reported in the table. There have not been reports since 2013-14 under these criteria. In addition, until the closure of Mair Bank to recreational fishing in 2014, tangata whenua may have harvested pipi under their recreational allowance and these are not included in records of customary catch.

Table 2: Fisheries New Zealand records of customary harvest of pipi (approved and reported as weight (kg)) in PPI 1A, between 2008–09 and 2012-13. No data since 2013-14.

	Weight (kg)	
Fishing year	**Approved**	**Harvested**
2008–09	120	120
2009–10	235	235
2010–11	100	100
2011–12	80	40
2012–13	110	110

For further information on customary fisheries refer to the Introduction – Pipi chapter.

1.4 Illegal catch

For further information on illegal catch refer to the Introduction – Pipi chapter.

1.5 Other sources of mortality

There is some concern about the possibility of changes in bank stability that could arise from operations other than fishing in Whangarei Harbour (e.g., harbour dredging, port developments), which could lead to changes in the pipi fishery. Radical changes to the local hydrology could affect the size or substratum of Mair Bank, with consequent effects on its pipi population. Also, as suspension feeders, pipi may be adversely affected by increased sediment loads in the water column.

The potential causes of low biomass from the 2014 biomass survey were investigated in the desktop report of Williams & Hume (2014). They concluded that: *"potential causes of the pipi decline were high natural mortality of an ageing pipi population and low recruitment, both of which may be related to observed changes in the morphology of Mair Bank. There was no evidence of disease in the population, and the decline did not appear to be associated with potential anthropogenic sources of mortality (e.g., sedimentation, contaminants, harvesting). It is possible that substances not measured in shellfish, sediment, or water quality monitoring work may have influenced the pipi decline*."

2. BIOLOGY

This is covered in the Introduction – Pipi chapter.

3. STOCKS AND AREAS

Little is known of the stock structure of pipi. The commercial fishery based on Mair Bank in Whangarei Harbour (PPI 1A) forms a geographically discrete area and is assumed for management purposes to be a separate stock.

4. STOCK ASSESSMENT

Stock assessment for Mair Bank pipi was conducted in 2005 and 2010 using absolute biomass surveys and yield per recruit and spawning stock biomass per recruit modelling. MPI, in association with Northland Regional Council and the Harbour board, also commissioned a biomass survey in 2014 in response to local concerns about low biomass.

Following the closure to the collection of pipi on Marsden Bank in February 2011, the Bank was included in the monitoring programme in 2010–11 and has been surveyed four times since then. The population has fluctuated over time. In view of the population decline recorded in 2013–14, the 2018 survey data indicate some recovery of the pipi population, including the presence of recruits (Berkenbusch and Neubauer, 2018). Pipi were absent at Marsden Bank in 2021–22, and none of the 60 monitoring samples contained any pipi (Berkenbusch et al., 2022).

4.1 Estimates of fishery parameters and abundance

Estimates of the fishing mortality reference point $F_{0.1}$ are available from yield per recruit modelling (Table 3). Parallel spawning stock biomass per recruit modelling was conducted to estimate the SSBPR corresponding with each estimate of $F_{0.1}$. These estimates are sensitive to the assumed value of natural mortality (M) and uncertainty in pipi growth parameters.

4.2 Biomass estimates

Virgin biomass (B_0) and the biomass that will support the maximum sustainable yield (B_{MSY}) are unknown for Mair Bank pipi. Only four biomass estimates have been made for the Mair Bank pipi population: in 1989 using a grid survey, in 2005 using stratified random sampling, in 2010 using a systematic random start and in 2014 using a stratified grid sampling design. The 1989 estimate of 2245 t (± 10%) can be considered conservative because only the intertidal area of the bank was surveyed, and pipi are known to exist in the shallow subtidal area of the bank. Estimates of biomass are available for Mair Bank (excluding from the 2014 survey) and are sensitive to the assumed size at recruitment (Table 4). The high CV for the 2014 estimates were due to unexpectedly low and patchy biomass at the time.

Table 3: Estimates of the reference rate of fishing mortality $F_{0.1}$ and corresponding spawning stock biomass per recruit at three different assumed rates of natural mortality (M) for two harvest strategies ('no restriction' and 'current'). SL, shell length (at recruitment). Estimates from Williams et al (2007).

'No restriction' strategy (harvest pipi of a size that maximizes YPR)					
Assumed M	Optimal age at recruitment (y)	SL (mm)	$F_{0.1}$	YPR (g)	SSBPR (%)
0.3	3	52	0.437	4.93	44
0.4	2.75	51	0.550	3.50	45
0.5	2.5	49	0.648	2.58	45
'Current' strategy (harvest pipi 60 mm and over)					
Assumed M	Age at recruitment (y)	SL (mm)	$F_{0.1}$	YPR (g)	SSBPR (%)
0.3	5	60	0.564	3.98	62
0.4	5	60	0.755	2.41	70
0.5	5	60	0.949	1.47	76

Table 4: Estimated recruited biomass (B) of pipi on Mair Bank in 2005 and 2010 for different assumed sizes at recruitment to the fishery. Source: Williams et al (2007), Pawley et al (2013) and Pawley (2014).

Year	Assumed shell length at recruitment (mm)	Intertidal stratum		Subtidal stratum		Mair Bank Total	
		B (t)	CV (%)	B (t)	CV (%)	B (t)	CV (%)
2005	1 (total biomass)	3 602	11.4	6 940	19.5	10 542	13.4
2005	40	3 569	11.4	6 922	19.5	10 490	13.4
2005	45	3 434	11.4	6 791	19.6	10 226	13.6
2005	50	2 986	11.3	5 989	20.1	8 975	14.0
2005	55	2 022	11.1	3 855	23.8	5 877	16.0
2005	60	1 004	13.1	2 013	37.5	3 017	25.4
2010	1 (total biomass)	2 233	17.4	2 218	33.0	4 452	15.2
2010	50	2 001	18.1	1 889	36.0	3 890	16.6
2010	60	1 751	18.3	1 393	33.7	3 145	17.4
2014	5 (total biomass)	46	50.8	28	25.9	73.5	30.8

4.3 Yield estimates and projections

Maximum Constant Yield (*MCY*) was estimated using method 2 (see the guide to biological reference points in the introduction chapter of this plenary document):

$$MCY = 0.5F_{0.1}B_{av}$$

where $F_{0.1}$ is a reference rate of fishing mortality and B_{av} is the historical average recruited biomass (estimated as the mean recruited biomass from the 2005 and 2010 surveys). M is assumed to be 0.3 and the corresponding $F_{0.1}$ is 0.564 (Williams et al 2007 revised version). The size at recruitment is assumed to remain at 60 mm and the corresponding B_{av} is 3081 t.

$$MCY = 0.5 \times 0.564 \times 3\,081\ t$$
$$= 869\ t$$

This estimate of *MCY* would have a CV at least as large as those associated with the 2005 and 2010 estimates of recruited biomass (17–25%), and is sensitive to the assumed size at recruitment to the fishery, the assumed natural mortality, and to uncertainty in $F_{0.1}$ (arising from the considerable uncertainty in model input values for growth and M) (Table 5).

Table 5: Sensitivity of maximum constant yield (*MCY*, method 2) to estimates of size at recruitment and the assumed natural mortality, M. B_{av}, the historical average recruited biomass, was estimated for two sizes at recruitment (50 and 60 mm SL) using the 2005 and 2010 survey data.

SL at recruitment (mm)	B_{av}	M	$F_{0.1}$	*MCY* (t)
50	6433	0.3	0.40	1 300
		0.4	0.54	1 729
		0.5	0.68	2 182
60	3081	0.3	0.56	869
		0.4	0.76	1 163
		0.5	0.95	1 462

CAY was not estimated because there is no estimate of current biomass.

5. STATUS OF THE STOCKS

Stock Structure Assumptions
For the purpose of this assessment PPI 1A is assumed to be a discrete stock. The assessment is done for Mair Bank within Whangarei Harbour.

Stock Status		
Most Recent Assessment Plenary Publication Year	2015	
Catch in most recent year of assessment	Year: 2013–14	Catch: 0 t
Reference Points	Target: Default 40% B_0 Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: F_{MSY}	
Status in relation to Target	Very Unlikely (< 10%) to be at or above the target	
Status in relation to Limits	Soft Limit: Very Likely (> 90%) to be below Hard Limit: Very Likely (> 90%) to be below	
Status in relation to Overfishing	Unknown	

Historical Stock Status Trajectory and Current Status
Biomass has not been measured in consistent units for all surveys, but has declined sharply from a total biomass (> 1 mm) of 10 542 tonnes in 2005 to a total biomass (> 5 mm) of 73.5 tonnes in 2014.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Surveys were conducted in 2005, 2010 and 2014. These surveys have shown a sharp decline in biomass to very low levels.
Recent Trend in Fishing Intensity or Proxy	No commercial landings have been reported since the 2011–12 fishing year.
Other Abundance Indices	-
Trends in Other Relevant Variables or Indicators	-

Projections and Prognosis	
Stock Projections or Prognosis	The stock has declined below limits (causing the fishery to be closed) due to unknown reasons and the likelihood of recovery is unknown.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	There is no current legal catch as biomass has declined below the TACC and limits.
Probability of Current catch or TACC causing Overfishing to Continue or to commence	There is no current legal catch as biomass has declined below the TACC and limits. However, the amount of illegal take is unknown.

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Reference rate of fishing mortality applied to absolute biomass estimates from quadrat surveys	
Assessment Dates	Latest assessment Plenary publication year: 2012	Next assessment: Unknown
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Two absolute abundance estimates (quadrat surveys)	1 – High Quality

	- Biological parameters for YPR/SSBPR models	1 – High Quality
Data not used (rank)	-	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Growth for the subtidal portion of this population is poorly known. The available data come from other areas or the intertidal portion, both of which can be expected to support slower growth than the area where the fishery occurs. This, together with poor information on M and the size at recruitment to the fishery, makes the YPR modelling and reference rate of fishing mortality very uncertain.	

Qualifying Comments
Recruitment appears from the 2005 and 2010 survey length frequency distributions to be variable. This may lead to larger variations in the spawning and recruited biomass than the estimates of biomass suggest. The 2014 survey showed very low biomass levels and the commercial, recreational and customary fisheries have been closed since 1 October 2014.

Fishery Interactions
This is a hand-gathering fishery with no substantial bycatch or other interactions.

6. FOR FURTHER INFORMATION

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